SL: Quick Review for Exam

T08D10 – Unit Exam Tuesday

Acid-Base Definitions

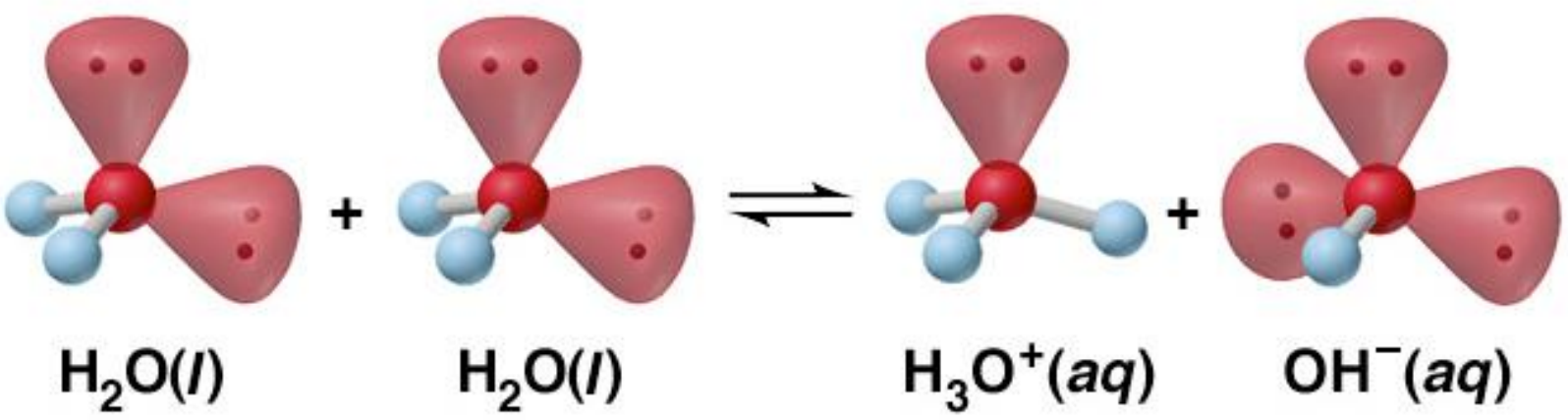
Acids

- generate H^+ in water
- H^+ donors
- excess H^+

Bases

- generate OH^- in water
- H^+ acceptors
- Excess OH^-

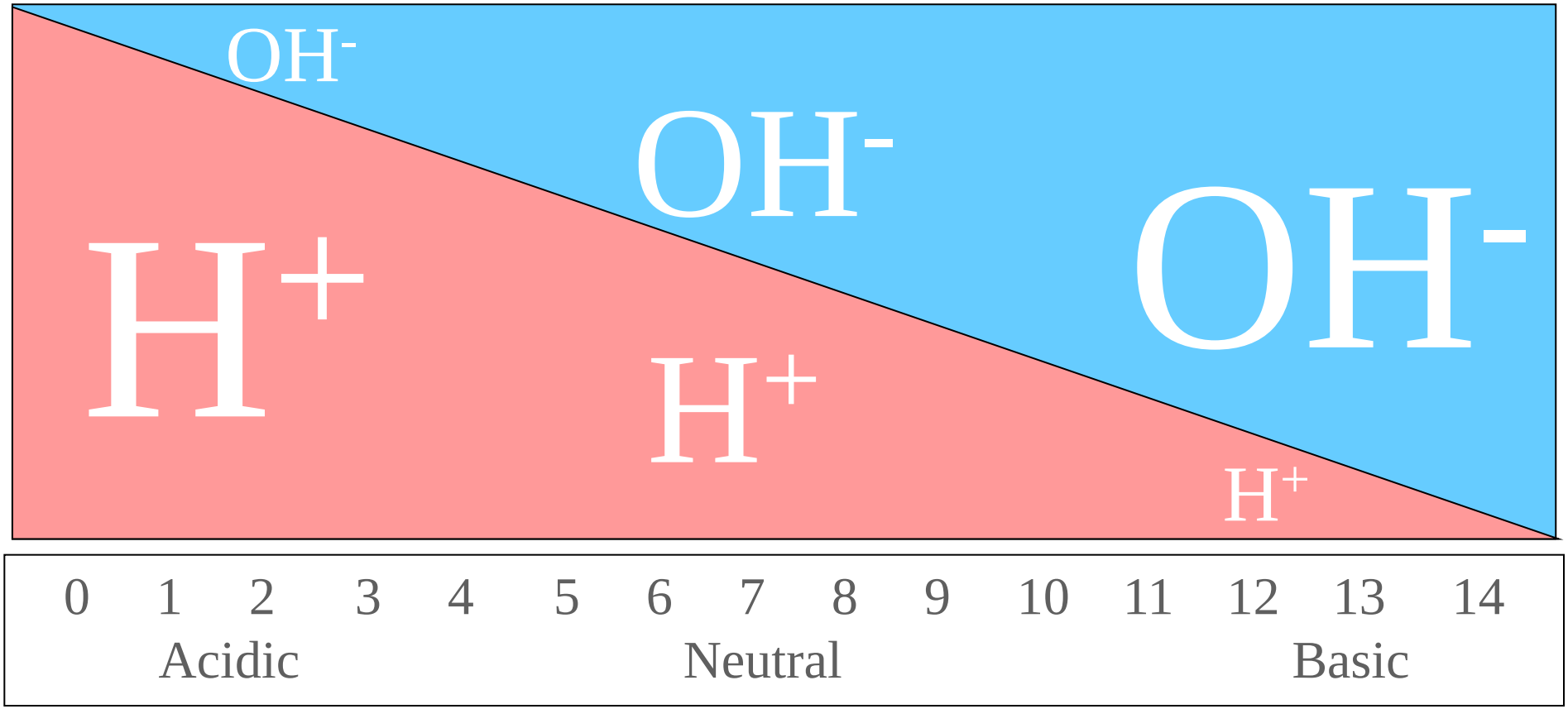
Equilibrium in Water



$$K_{eq} = K_w = [H_3O^+][OH^-] = [H^+][OH^-] = 1\times10^{-14}_{@25^o}$$

Small K ≡ equilibrium favors reactants

As [H^+] rises, [OH^-] falls



H^+ and pH

$$K_w = [H^+][OH^-] = 1 \times 10^{-14}$$

$$[H^+] = \frac{K_w}{[OH^-]}$$

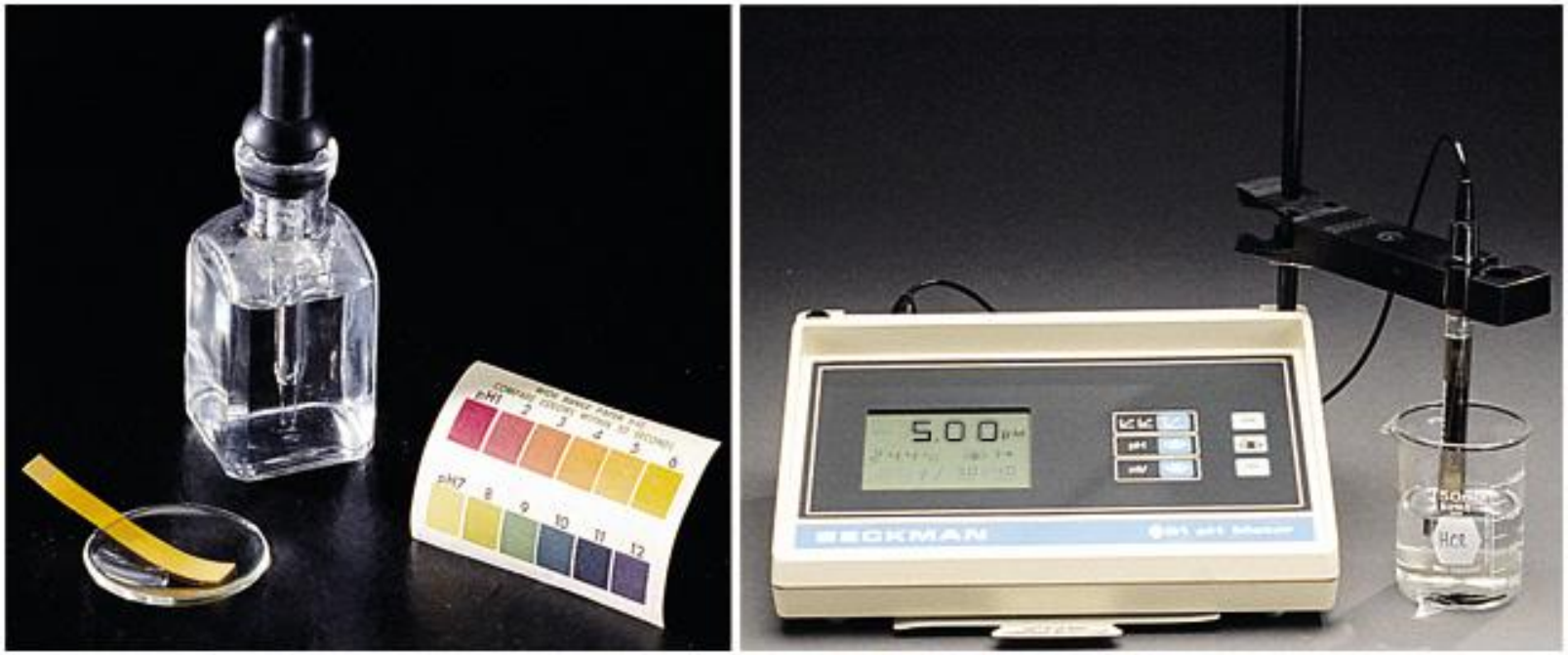
$$pH = -\log [H^+]$$

$[H^+]$	1×10^0	to	1×10^{-14}	in water
pH	1	to	14	in water

Relationships

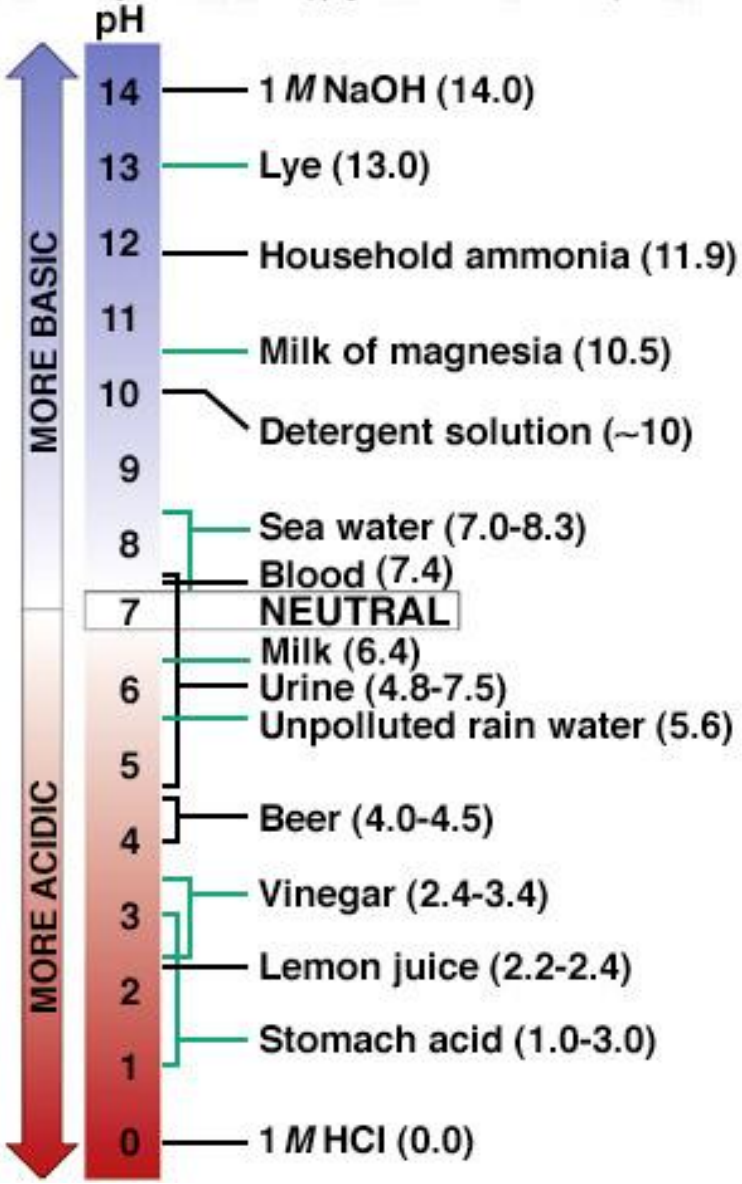
H^+	H_2O	OH^-
$[H^+] > [OH^-]$	$[H^+] = [OH^-]$	$[H^+] < [OH^-]$
Acidic solution	Neutral solution	Basic solution
pH < 7	pH = 7	pH > 7

Methods for Measuring pH



A B

Some pH Values

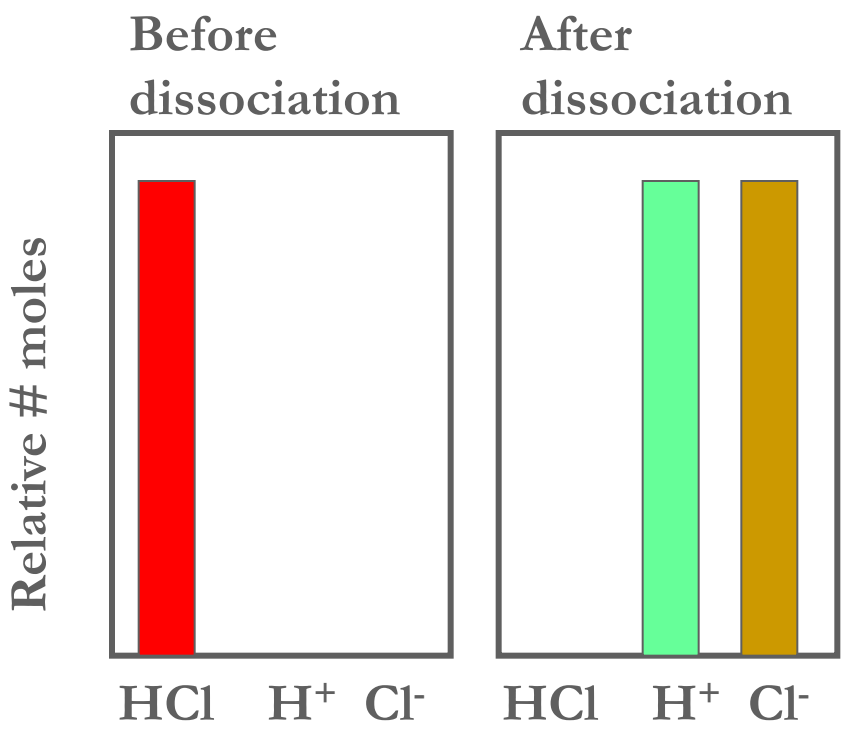


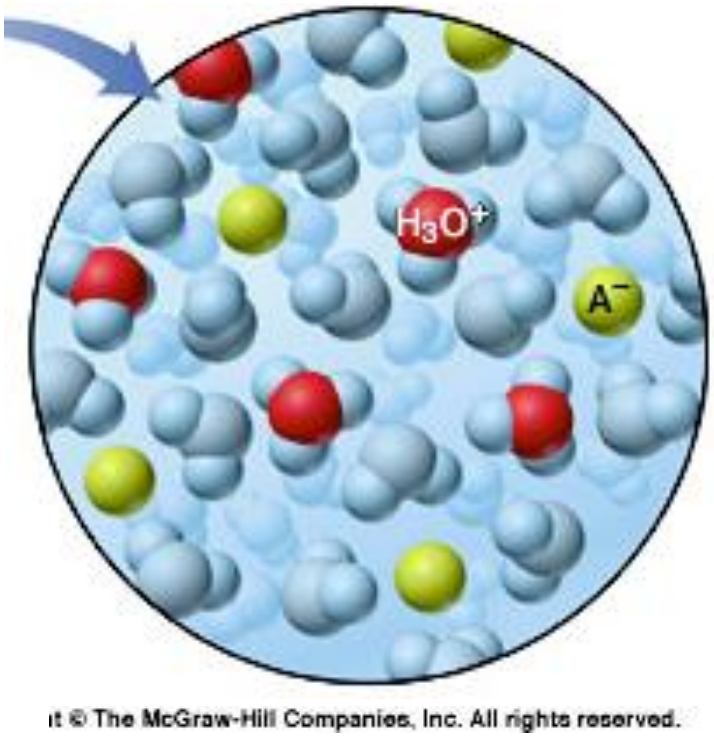
Strong Acids (exp. 7)

100% dissociation / good H^+ donor

equilibrium lies far to right

$HA \rightarrow H^+ + A^-$



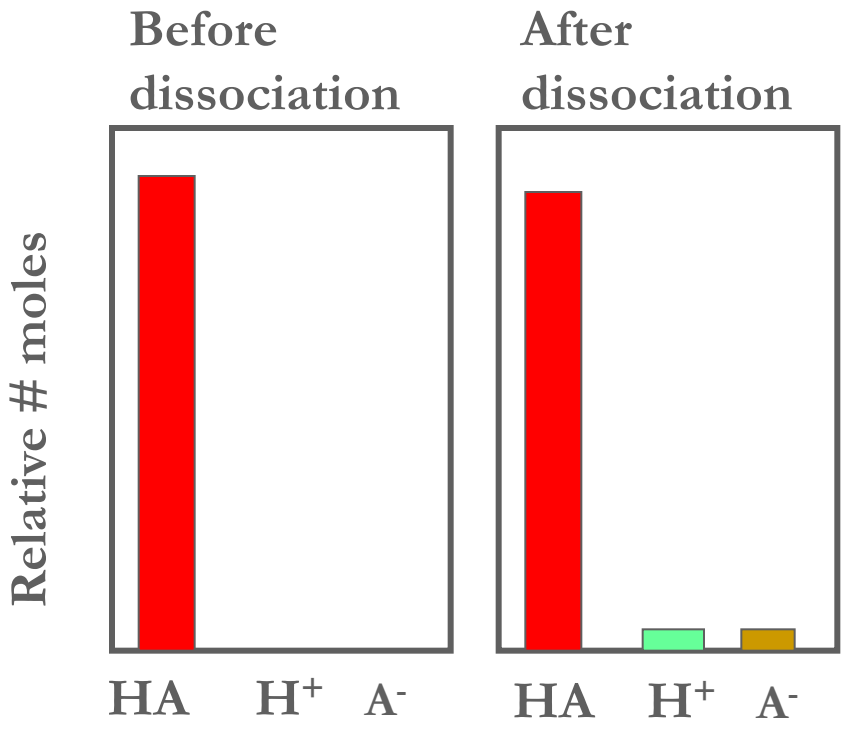


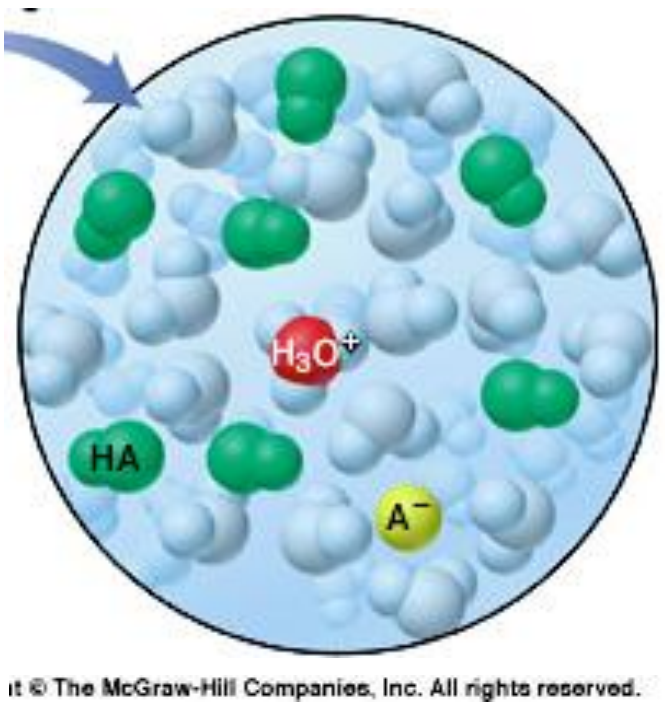
Weak Acids (exp. 13)

<100% dissociation / not-as-good H^+ donor

equilibrium lies far to left

$HA \rightleftharpoons H^+ + A^-$





Acid Dissociation Constant

For a weak acid:

$$HA \rightleftharpoons A^- + H^+$$

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

←amount dissociated

←amount undissociated

$$10^{-2} < K_a < 10^{-7}$$

$$2 < pK_a < 7$$

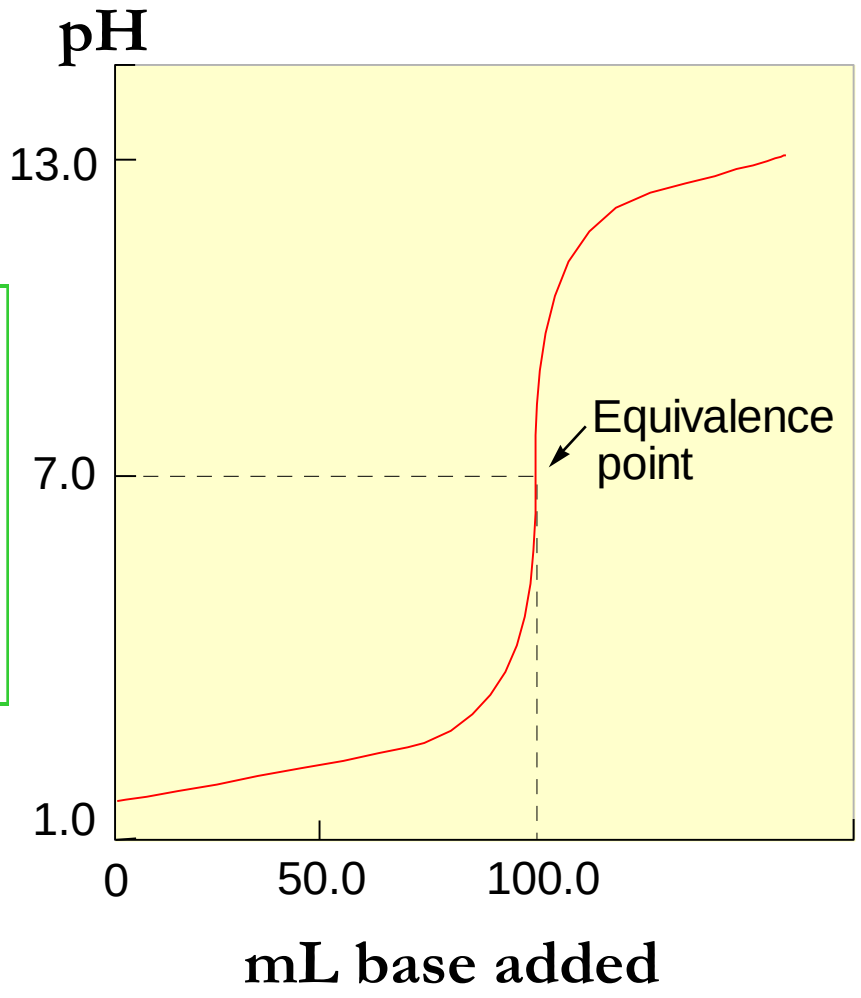
Strong acid-strong base titrations

At equivalence point, V_{eq}:

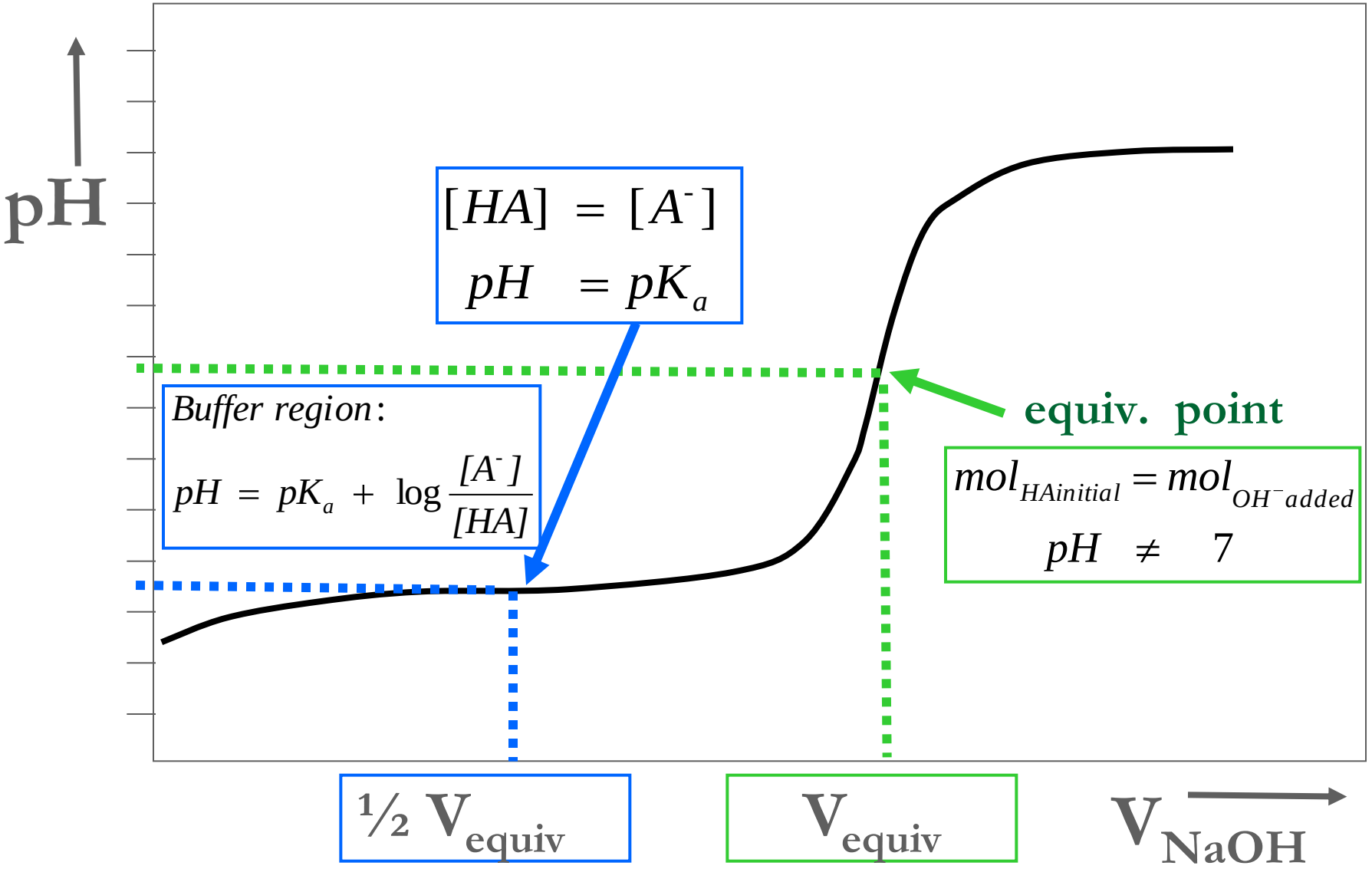
$$mol\ H^+ = mol\ OH^-$$

$$n_{HA_{initial}} = n_{OH^-_{added}}$$

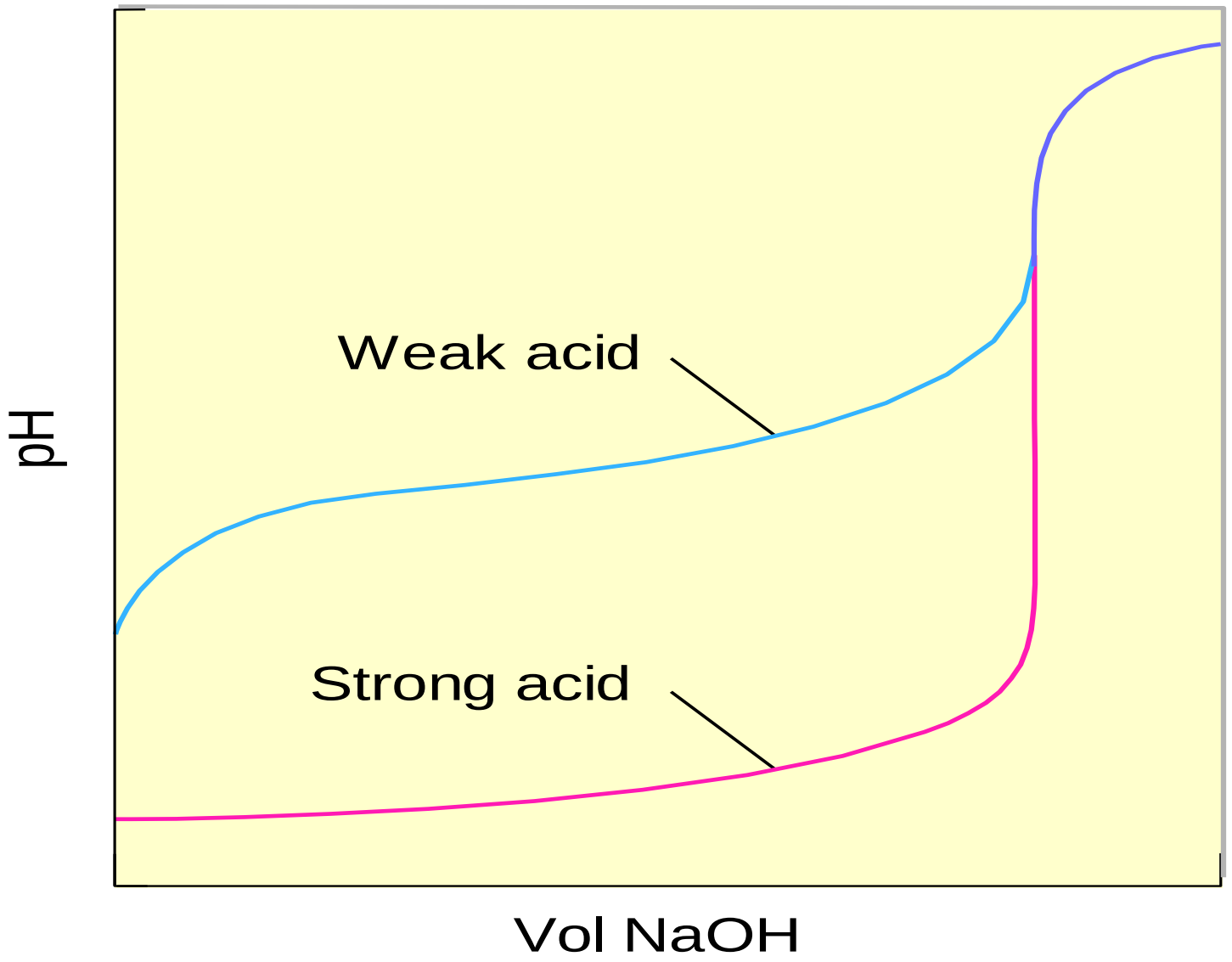
$$n_{HA_{initial}} = V_{OH^-_{added}} \times M_{OH^-_{added}}$$



Weak acid-strong base titrations



Differences in pH curves



Key points on the pH curve

$$HA + OH^- \rightleftharpoons A^- + H_2O$$

1) ½ V_{equil}

$$[HA] = [A^-]$$

$$pH = pK_a \neq 7$$

2) V_{equil}

$$mol_{OH^- added} = mol_{HA initial}$$

$$n_{OH^- added} = n_{HA initial}$$

$$V_{OH^- added} \times M_{OH^- added} = n_{HA initial}$$

$$pH \neq 7$$

Example Titration Curve

$\frac{1}{2}V_{eq} \sim 8.6$ mL

pH $\sim$ 3.5

$pK_a \sim 3.5$

$V_{eq} \sim 17.2$ mL

pH $\sim$ 7.8

$n_{HA} \sim 1.7\ 10^{-3}$